Turbomolecular Pump Station (TMPS) Standardization

Considerations for Turbomolecular Pump Station Requirements

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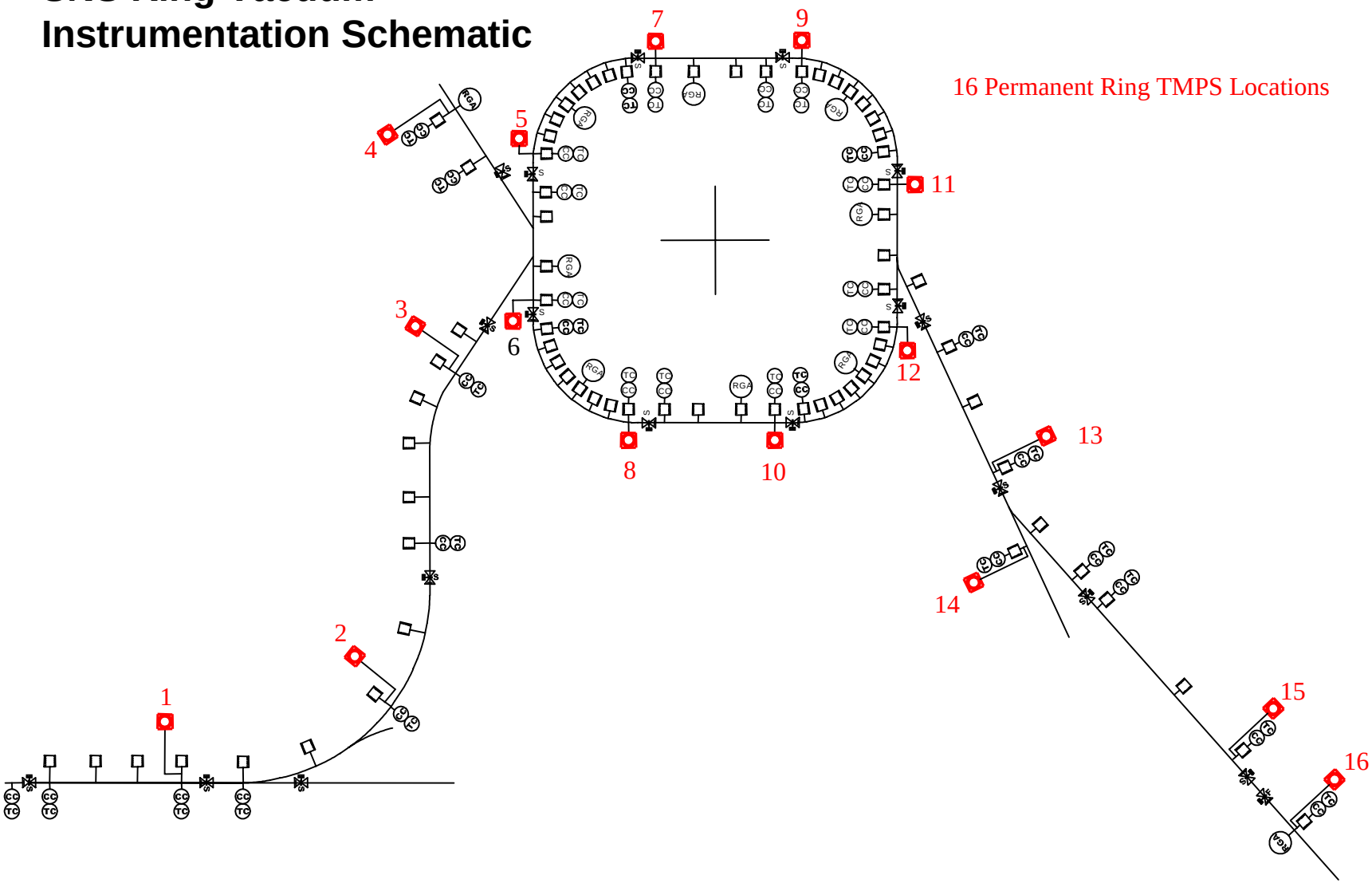
TMPS Standardization Considerations

- Applications & Scope
- Performance & Operating Requirements
- Operating Environments
  - » Rad Hard TMP and Electrical Components
- High & Low Level Control System Interface
  - » Proposed Schematic
- Issues

Application & Scope

- LINAC
  - »Roughing
  - »Insulating Vacuum, Permanent
- Ring
  - »Roughing
  - »Ion Pump Protection, Permanent (13)
  - »Pumping at Beam Dump Windows (3)
  - »Supplemental Ion Pump Protection, Temporary (2)
  - »Quantity of 18

SNS Ring Vacuum Instrumentation Schematic



Performance & Operating Requirements

- Performance
  - »Pumping Speed
    - – <200 Liters/sec Covers all Ring applications
  - »Design Base Pressure
    - – *<1x10^{-8} Torr* Covers all Ring applications
- *Operating Modes*
  - »*Portable*
  - »*Roughing, Pumping*
  - »*Local, Remote*
  - »*Interlocks*
    - – *Pump station protection*
    - – *Accelerator Protection*

Operating Environments

- Ring
  - » Residual Activation
    - – ALARA: Impact to Personnel Activities
      - Entire Station is permanent
      - Turbopump is permanent
  - » High Radiation During Operation
    - – Impact on Component Designs
    - – Possible Impact on Remote Operation Design
    - – Possible Impact on Installation Design
- LINAC
  - » *Low Radiation*
    - – *Less Restrictive*

Example of a Rad Hard TMPS electrical component

- radiation exposure to 10^8 rad = 10^6 J / kg

- **The mechanical Frequency Converter TCP 010 drives the PFEIFFER TMH/U 260 with three-pase current. It generates the drive frequency for the rotation speed of the pump and is suitable for the operation of systems where there is a high incidence of radiation and interference voltage peaks.**

- **Uses an electro-motoric drive without semi-conductors.**
- **Turbopump is monitored and interlocked with the TCP 010 and TCA 010.**
- **The integrated thermo switch operates in conjunction with the TCA 010 to switch off the frequency converter when the permissible temperature is exceeded**

Example of a Rad Hard Turbopump

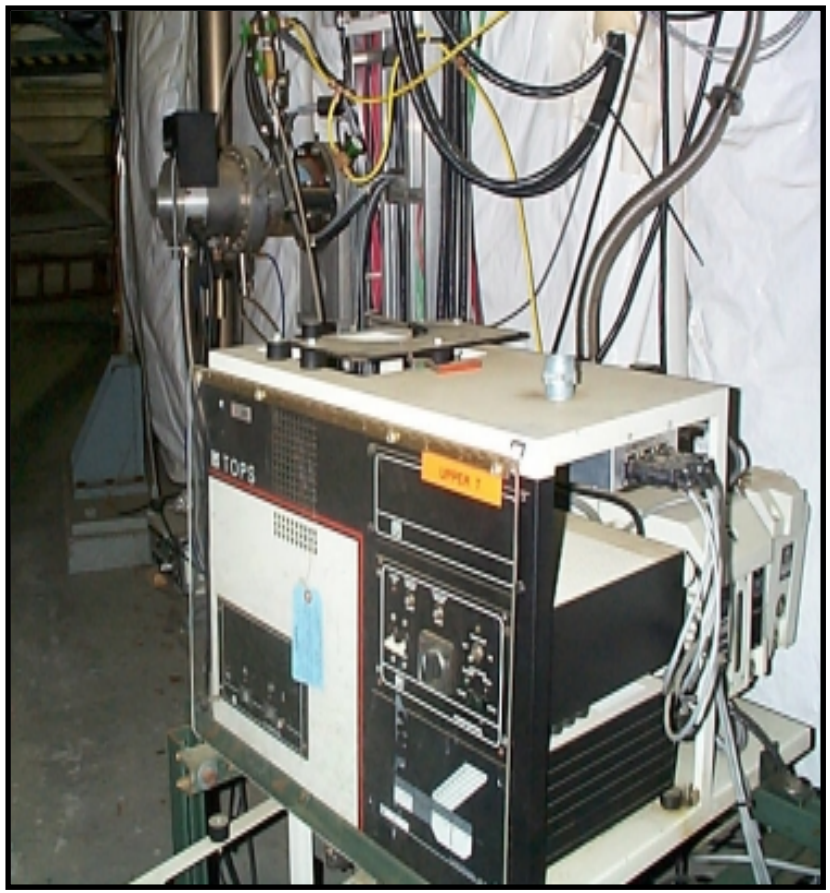
- radiation exposure to 10^8 rad = 10^6 J / kg
- Includes metal seals in body and hall probes for speed measurement
- Compound pump, suitable for UHV vacuum with dry backing pump (i.e., high compression ratio).

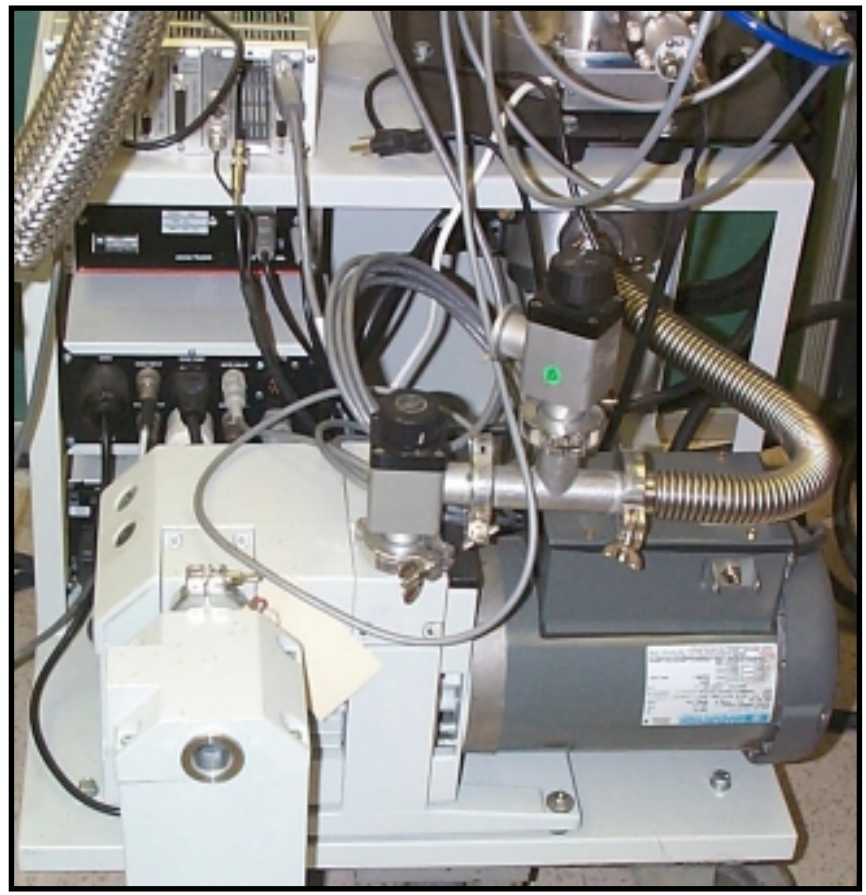
8. Technical Data

Feature	Unit	TMH 260 / TMH 260 P	TMU 260 / TMU 260 P
Connection nominal diameter			
Inlet		DN 100 ISO-K	DN 100 CF-F
Outlet		DN 25 ISO-KF/G 1/4"	
Venting connection		G 1/8"	
Frequency Converter		TCP 010	
Nominal rotation speed	1/min	45 000	
Run-up time (up to 90% of the rated rotation speed)	min	3	
Noise level	dB (A)	< 50	
Final pressure, backing pump	mbar	< 5	
Max. permissible rotor temperature	°C	90	
Permissible heat radiation power	W	6	
Volume flow rate for:			
Nitrogen N_2	l/s	160	
Helium He	l/s	165	
Hydrogen H_2	l/s	100	
Max. gas throughput [1]			
N_2	mbar l/s	3.5	
He	mbar l/s	4.0	
Final pressure [2]			
with rotary vane vacuum pump	mbar	$5 \cdot 10^{-10}$	
with diaphragm vacuum pump	mbar	$1 \cdot 10^{-8}$	

G-2 Turbo station

- 100% vendor items





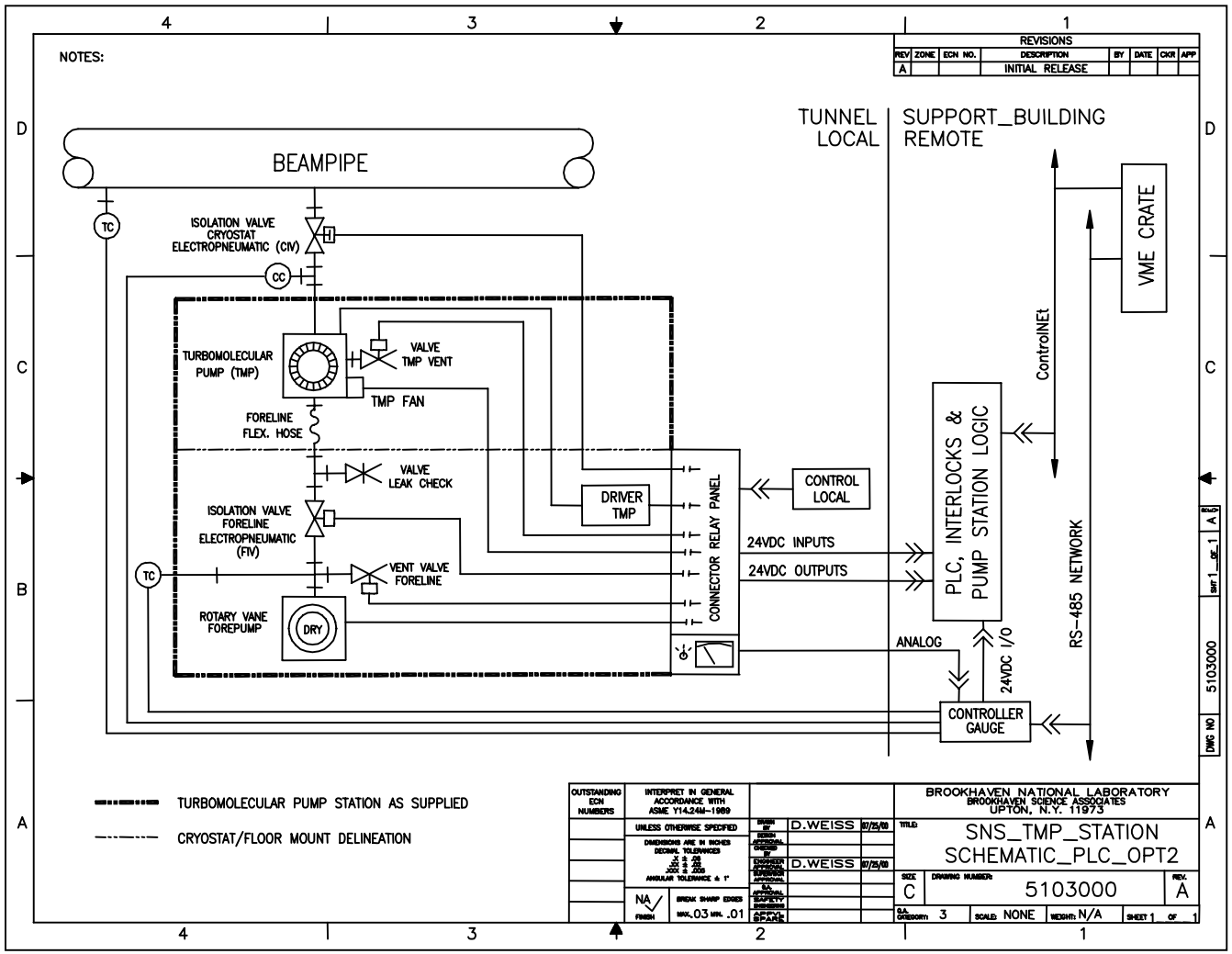
High & Low Level Control System Interface

- Electromechanical based local interface(1)
- I/O based remote interface(1)
  - » PLC Architecture supports approach
    - – Quantity I/O
    - – independent PID loops
- Interlocks *(Low and/or High Level Control)* (1,2)
  - » *Pump station protection*
  - » *Accelerator Protection*

(1) Unless shielding of electronics is implemented, or rad hard components are identified.

(2) Some interlocking features may be incorporated at the local (low) level depending on vendor products.

Electromechanical Based System Schematic



TMPS Standardization Issues

- Applications and Scope
  - » Applications are similar
  - » Non-standard features (if needed) should be cost effective for required quantities
- Performance & Operating Requirements
  - » All requirements point to a common pumping system
  - » Identify portability (or other logistical) requirements combined with need for remote control
- Operating Environments
  - » Radiation environment in ring (ALARA) is most restrictive TMPS consideration
  - » Commercially available rad hard electronics?
    - – eliminates any need for custom boxes
    - – degree may dictate component placement and shielding
- High & Low Level Control System Interface
  - » *I/O (& analog) baseline*
  - » *Back-up is RS-485 network if rad hard components are identified*
  - » *Establish interlock and I/O requirements for each application*
- Need to identify other vendors and products suitable for radiation environment
  - ~$15k per station